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Re-evaluation Note REV2016-10

Special Review of Chloropicrin: Proposed Decision for Consultation

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Publications
Pest Management Regulatory Agency
Health Canada
2720 Riverside Drive
A.L. 6607 D
Ottawa, Ontario K1A 0K9

Internet: pmra.publications@hc-sc.gc.ca
healthcanada.gc.ca/pmra
Facsimile: 613-736-3758
Information Service:
1-800-267-6315 or 613-736-3799
pmra.infoserv@hc-sc.gc.ca

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1.0 Introduction

Pursuant to subsection 17(2) of the *Pest Control Products Act* (PCPA), the Pest Management Regulatory Agency (PMRA) has initiated a special review of registered pest control products containing chloropicrin based on the European Commission decision concerning the non-approval of chloropicrin as a plant protection product in the European Union (European Commission, 2011a; European Commission, 2011b). The initiation of the special review of chloropicrin was announced in December 2013 (Canada, 2013).

As required by subsection 18(4) of the *Pest Control Products Act*, the PMRA has evaluated the aspects of concern that prompted the special review of pest control products containing chloropicrin. The aspects of concern are relevant to human health and the environment, and were identified as: (1) potential risk to handlers, (2) potential for chloropicrin to leach to groundwater, (3) potential for long-range atmospheric transport, (4) potential risk to aquatic organisms, and (5) potential risk to birds and mammals.

2.0 Uses of Chloropicrin in Canada

Chloropicrin is a non-selective pre-plant soil fumigant and antimicrobial used to control various pests such as insects, nematodes, bacteria, fungi and weeds. It is currently registered as a soil fumigant on tobacco, strawberry, raspberry, vegetables (for example, tomatoes and peppers), ornamentals and forest nurseries. Chloropicrin is applied by ground equipment and incorporated into the soil by injection (closed delivery system). Applications are typically once per year and are either broadcast or banded (in strips, rows or beds). Treated soil is immediately sealed and subsequently aerated prior to planting. Chloropicrin is also used as a remedial wood preservative to treat structural timber such as poles. The pressurized liquid is injected into pre-drilled holes and immediately sealed with treated wood plugs (outdoor application only).

In 2014, the PMRA implemented extensive risk reduction measures to further protect human health and the environment (Canada, 2012a; Canada, 2012b; Canada, 2012c).

Currently, there is one technical grade active ingredient, three restricted class products (soil fumigation) and one commercial class product (wood preservation) registered in Canada (Appendix I). The proposed special review decision is applicable to all registered products containing chloropicrin.

3.0 Aspects of the Pest Control Product that Prompted the Special Review

The use of chloropicrin as a pesticide in the European Union Member States was prohibited in 2011 due to human health and environmental concerns (European Commission, 2011a; European Commission, 2011b). The European Commission's review report in support of the decision indicates that, "*concerns were identified with regard to: the risk to operators; the risk for groundwater contamination; the risk for long-range atmospheric transport; the risk to aquatic organisms; the risk to birds and mammals*" (European Commission, 2011a).

It is noted that the European Commission decision (European Commission, 2011b) cited data gaps pertaining to insufficient information, but did not identify specific risk concerns (related to these gaps). Therefore, data gaps are not included as aspects of concern for the special review of chloropicrin.

The European assessment evaluated the use of chloropicrin as a pre-plant soil fumigant. Operators were defined as tractor drivers, till operators, tarp sealers and assistants during application. The European term "operators" is considered equivalent to the term "handlers" used by the PMRA. The risk of concern to operators identified in the European assessment was related to inhalation exposure from soil fumigant applications.

Based on the available information from the European Commission, the aspects of concern to be evaluated that prompted the special review of pest control products containing chloropicrin are:

- Potential risk to handlers
- Potential for chloropicrin to leach to groundwater
- Potential for long-range atmospheric transport
- Potential risk to aquatic organisms
- Potential risk to birds and mammals

4.0 PMRA Evaluation of the Aspects of the Pest Control Product that Prompted the Special Review

Following the initiation of the special review of chloropicrin, the PMRA requested information from provinces and other relevant federal departments and agencies, in accordance with subsection 18(2) of the *Pest Control Products Act*. No information related to the aspects of concern was received.

To evaluate the aspects of concern related to human health and the environment, the PMRA has considered available relevant scientific information. This includes information considered for the re-evaluation of chloropicrin (Canada, 2012a; Canada, 2012b; Canada, 2012c; United States, 2008a; United States, 2008b; United States, 2009a; United States, 2009b), as well as other relevant information, for example, available monitoring data, information from the Canadian incident report database, information from the United States Environmental Protection Agency (US EPA; United States, 2013) and from the European Union (European Commission, 2011a; European Commission, 2011b; EFSA, 2011).

4.1 Potential risk to handlers

To evaluate chloropicrin's potential risk to handlers, the PMRA considered relevant scientific information pertaining to its toxicological profile, the existing conditions of use, as well as the current risk reduction measures.

Soil fumigation

Soil fumigant "handlers" are considered to be any persons involved in the use of the product. This includes: loading/applying the product, perforating/removing tarps, cleaning spills, as well as handling, cleaning, and/or repairing machinery or containers.

The potential for soil fumigant handler exposure is greatest during the application. Due to the volatile nature of chloropicrin, the major route of exposure is inhalation. Based on the current use pattern, the primary durations of exposure are acute, short- and intermediate-term. Long-term inhalation exposure is not expected, even for commercial applicators, since the product is typically applied only once per year on a seasonal basis.

Chloropicrin is a sensory irritant that stimulates the trigeminal nerve mediating sensations in the nose, eyes, throat, and upper respiratory tract. In humans, eye irritation, a reversible effect, was identified as the most sensitive endpoint for acute exposure. Animal studies indicate that repeat exposures may result in nasal and lung effects. Based on a review of available information, the chloropicrin database contains the full complement of required studies including a reproductive inhalation study in rats, and developmental toxicity (inhalation) studies in rats and rabbits (United States, 2009a; United States, 2009b). No concern for potential pre- or postnatal toxicity as a result of exposure to chloropicrin was identified.

Inhalation exposure to chloropicrin depends on its air concentration in the handler breathing-zone, i.e. the concentration of chloropicrin that volatilizes off a treated field in the vicinity of the handler. Chloropicrin emissions from a treated field are variable and affected primarily by the amount of chloropicrin applied, application methods and equipment, sealing technologies, and field conditions. Soil factors that can potentially have an impact on the magnitude of the air concentration include soil type, soil moisture, soil temperature, and organic content of the soil.

As part of the exposure assessment, the PMRA considered chloropicrin air monitoring data from field volatility studies conducted in the United States (United States, 2009b). The application methods relevant to Canada included broadcast and banded soil injection. The data were for fumigant handlers performing various tasks during application (for example, tractor drivers, soil sealers, tarp removers). Based on the air monitoring data and the toxicity of chloropicrin, risks of concern for handlers were identified for some scenarios. As a result, the PMRA implemented extensive risk reduction measures in 2014 to minimize chloropicrin emissions and potential handler exposures from soil fumigant applications (Canada, 2012a), which include:

- A site-specific Fumigation Management Plan (FMP) is required for each application. The FMP will ensure that all chloropicrin applications are well planned to help ensure a safe and effective fumigation. The plan is required to be developed prior to the start of application and to cover key steps including: monitoring of site conditions; following the mandatory good agricultural practices (GAPs); ensuring the availability of personal protective equipment (including respirators); and emergency response planning.

- Clarifications on the nature of restriction for soil fumigant end-use products (i.e., to be used only in conjunction with an FMP, and indicating on all soil fumigant labels that the products are only to be used by individuals holding an appropriate pesticide applicator certificate or license recognized by the provincial/territorial pesticide regulatory agency where the pesticide application is to occur).

- At least two fumigant handlers must be present at all times to monitor one another.

- To reduce volatilization from treated fields, mandatory GAPs must be followed. These application practices include monitoring of weather conditions (to identify conditions that are unfavourable for soil fumigation), monitoring of soil temperature and moisture, and proper soil preparation and soil sealing. Fumigant must be injected into soil a minimum of 20 cm below the surface and immediately sealed. The soil must meet strict criteria for moisture and temperature to ensure fumigant remains in the soil and is not released.

- All labels have relevant hazard statements and warning/precautionary directions, including personal protective equipment for dermal and inhalation protection, i.e. loose-fitting or well ventilated long-sleeved shirt, long pants, chemical-resistant gloves, a chemical-resistant apron, chemical-resistant footwear with socks, protective eyewear, and when applicable, an air-purifying respirator.

- All labels include directions for respiratory protection and stop-work triggers. Specifically, if at any time any handler experiences sensory irritation (tearing, burning of the eyes or nose) or if chloropicrin air concentrations are at or above 0.15 ppm, then an air-purifying respirator is required or operations must cease and handlers not wearing a respirator must leave the application area. Monitoring of breathing zone samples must also be conducted prior to handlers resuming work activities.

- All labels include directions for spill or leak procedures, indicating that entry into the spill or leak area is prohibited until chloropicrin air concentrations have decreased to less than 0.15 ppm and no sensory irritation is experienced.

Further, the measures require training, detection and response systems to be in place should an accident or spill occur.

Based on the current conditions of use, including the above risk reduction measures, the PMRA has determined that potential risks to handlers from soil fumigant use are not expected to be of concern.

No incidents related to soil fumigant handlers have been reported through the Health Canada Pesticide Incident Reporting Program (IRP).

Remedial wood preservation

For remedial treatment of wooden poles/timbers, "handlers" are considered any persons involved in the application of the product. Based on the currently registered use pattern, the product is injected into pre-drilled holes and immediately sealed with treated wood plugs (outdoor use only). Dermal and inhalation handler exposure is expected to be minimal based on the risk reduction measures that are implemented on the current label, which include:

- Personal protective equipment, i.e. long-sleeved shirt, long pants, shoes plus socks, chemical-resistant gloves, and a full facepiece air-purifying respirator or a gas mask with a canister approved for organic vapour during mixing, loading, transfer, application or any other handling activities;
- Instructions on spill or leak procedures, indicating that entry into the spill or clean-up area by unprotected persons is prohibited until the air concentration of chloropicrin is measured to be less than 0.15 ppm;
- Prohibition of indoor use; and,
- Relevant hazard and warning statements.

Based on these measures, the PMRA has determined that potential risks to handlers from remedial wood preservative use are not of concern under the current conditions of use.

No incidents related to handlers for the remedial wood preservative use have been reported in the Health Canada Pesticide IRP.

4.2 Potential for chloropicrin to leach to groundwater

To evaluate chloropicrin's potential for leaching to groundwater, the PMRA considered available relevant information (for example, environmental fate information from laboratory and field studies, groundwater modelling, and monitoring information).

Chloropicrin is soluble in water (1.621 g/L at 25 °C). Based on chloropicrin's vapour pressure (23.8 mm Hg at 25 °C) and Henry's Law Constant (2.05×10^{-3} atm·m^3/mole), volatilization is expected to be an important environmental route of dissipation. Chloropicrin is stable to hydrolysis at pH 5, 7 and 9, but is subject to photolysis in water ($t_{1/2}$ of 1.3 days) and air ($t_{1/2} \leq 8$ hours). In aerobic soil, chloropicrin is non-persistent. It is subject to biotransformation, with carbon dioxide being the terminal breakdown product (aerobic soil $t_{1/2}$ ranging from 3.7 to 4.5 days). Chloropicrin was also found to be non-persistent and subject to biotransformation in anaerobic aquatic systems ($t_{1/2} = 0.3$ days). Since chloropicrin is highly soluble in water and has low adsorption in soil (estimated soil adsorption coefficient, $K_{oc} = 36$ L kg^{-1}), chloropicrin in soil has potential for leaching. However, because chloropicrin is subject to rapid degradation in soil and water, the amount reaching groundwater is expected to be low. The octanol/water partition coefficient (log K_{ow}) is 2.38 and thus chloropicrin is not expected to bioaccumulate (United States, 2008a; United States 2009a).

In addition to the laboratory studies, the PMRA also considered field studies. The terrestrial field dissipation studies were conducted in California, where chloropicrin was applied to soil via shank injection followed by tarping for 48 hours. The calculated field dissipation half-lives were less than 21.7 hours (United States, 2008a).

Given the volatile nature of chloropicrin, the variability in emission rates from treated fields, the rapid degradation in soil and water, and how the current groundwater models are parameterised, the use of the available groundwater modelling (i.e. Leaching Estimation and Chemistry Model, LEACHM and the European FOCUS PEARL model) does not adequately predict potential levels of chloropicrin in groundwater. The European Commission used the FOCUS PEARL model; however, noted uncertainties with respect to the model's ability to account for volatilisation losses, which may result in leaching potential being overestimated (EFSA, 2011).

To assess the potential exposure to groundwater, the PMRA considered available groundwater monitoring data. No Canadian groundwater monitoring data on chloropicrin are available (upon request). However, information from American groundwater monitoring studies from California and Florida (the two largest users of chloropicrin in the U.S.) is available, and was considered. In California, a total of 1719 wells were sampled from 1989 to 2003. Approximately one third (585) of the wells were located in areas of confirmed prior chloropicrin use. Of these, 176 were located in highly vulnerable groundwater protection areas. There were no detections of chloropicrin. In Florida, a total of 37,437 well samples were analyzed over a 27-year period. Chloropicrin was detected in 22 of the samples (less than 0.1% of samples), at levels ranging from 0.02 to 1.2 µg/L. Only two of the detections were at levels equal to or higher than 0.1 µg/L; however, these were located in areas where chloropicrin was not registered for commercial use. The presence of chloropicrin in these samples may have been a result of its formation as a by-product of disinfection during the water treatment process.

Based on the available monitoring data and chloropicrin's environmental fate properties (i.e. high volatility and rapid degradation), the levels in groundwater are expected to be minimal. Therefore, residues of chloropicrin in drinking water (ground water) are not considered to be of concern to human health under the current conditions of use as a soil fumigant or a remedial wood preservative. However, to minimize the potential leaching of chloropicrin to groundwater, the labels of all registered soil fumigant products containing chloropicrin currently require an environmental hazard statement pertaining to leaching to groundwater, and recommended best practices under the mandatory GAPs. No further risk reduction measures beyond those currently on product labels are proposed.

Aggregate exposure is the total exposure to a single pesticide that may occur from food, drinking water, residential and other non-occupational sources as well as from all known or plausible exposure routes (oral, dermal and inhalation). There are no domestic class end-use products containing chloropicrin currently registered for use in Canada. Chloropicrin soil fumigant use is restricted, and the end-use products are not registered for use in residential areas. As noted above, under the current registration conditions, the use of chloropicrin as a soil fumigant or wood preservative is not expected to adversely affect groundwater as drinking water sources. On this basis, aggregate exposure is not expected and an aggregate risk assessment for chloropicrin is not required.

A common mechanism of toxicity has not been identified for chloropicrin and other active ingredients. Therefore, a cumulative risk assessment is not required for chloropicrin.

4.3 Potential for long-range atmospheric transport

Chloropicrin is considered to have high volatility based on its vapour pressure (23.8 mm Hg at 25°C) and has high potential to volatilize from water and moist soils based on its Henry's Law constant (2.05×10^{-3} atm•m^3/mole). However, it is susceptible to direct photolytic degradation in air ($t_{1/2} < 8$ hrs) and water ($t_{1/2}$ of 1.3 days), which limits its potential for long-range atmospheric transport (United States, 2008a; United States 2009a). No Canadian or American air monitoring data on chloropicrin are available. Overall, the PMRA concludes that while chloropicrin has high potential for volatilization in the environment, based on its rapid degradation, it is not expected to be subject to long-range atmospheric transport.

4.4 Potential risk to aquatic organisms

To evaluate chloropicrin's potential risk to aquatic organisms, the PMRA considered available relevant information (for example, toxicity data and surface water monitoring and modelling information). A search for surface water monitoring data for chloropicrin in Canada and the United States was undertaken by the PMRA. No Canadian or American surface water monitoring data on chloropicrin are available. The PMRA also considered surface water concentrations estimated using the Pesticide Root Zone Model (PRZM) and Exposure Analysis Modeling System (EXAMS) (United States, 2008a; United States, 2009a). However, given the volatile nature of chloropicrin, rapid transformation in the environment, use pattern (for example, method of application) and how the models are parameterised, the use of these models does not adequately predict potential runoff for the current soil fumigant use.

Chloropicrin is considered highly toxic to very highly toxic on an acute basis to both freshwater and estuarine/marine fish species, aquatic invertebrates and aquatic plants (United States, 2008a; United States, 2009a; United States, 2013). The most sensitive species were freshwater fish (rainbow trout, *Oncorhynchus mykiss*) and the vascular plant (duckweed, *Lemna gibba*) (United States, 2013). Chronic exposure to aquatic organisms is not anticipated based on the use pattern and fate parameters in soil and water (for example, photolytic half-life in water of 1.3 days).

Potential exposure of chloropicrin in aquatic environments may occur to a limited extent as a result of runoff from treated fields and drift of volatilized chloropicrin and redeposition through precipitation to the surrounding areas. The PMRA considered surface water concentrations estimated using the PRZM/EXAMS (United States, 2008a; United States, 2009a). Based on the peak surface water concentration of 0.079 mg/L, acute risk quotients for *O. mykiss* and *L. gibba* were 7 and 12, respectively; and therefore, exceeded the level of concern (LOC) of 1. However, as outlined above, the PMRA recognizes that these models do not accurately estimate surface water concentration due to runoff.

To minimize potential exposures to aquatic organisms, the PMRA implemented risk reduction measures in 2014 (Canada, 2012a) including mandatory GAPs (such as, for tarped applications, no perforation of tarps if rainfall is expected within 12 hours) and other best practices (for example, instructions to avoid application to areas with a moderate slope and when heavy rain is forecast; inclusion of vegetative strip between the treated area and the edge of the water body).

Based on the current use pattern, the risk reduction measures in place, and fate characteristics of chloropicrin, the PMRA has concluded that the potential risk to aquatic organisms from applications of chloropicrin as a soil fumigant is not expected to be of concern. Based on chloropicrin's use as a remedial wood preservative (injected into pre-drilled holes and sealed), environmental exposure is expected to be minimal and no further risk reduction measures beyond those currently on product labels are proposed.

No incidents related to this aspect of concern were submitted through the Health Canada Pesticide IRP. One incident report in the U.S. Ecological Incident Information System (EIIS) related to aquatic organisms was identified. In this incident, mortality in various fish species (10 cases) was reported. The EIIS categorized all cases as "Misuse (accidental)" and "highly probable".

4.5 Potential risk to birds and mammals

To evaluate chloropicrin's risk to birds and mammals, the PMRA considered available relevant information (for example, toxicity data, ambient air monitoring near soil fumigation sites, and air modelling information).

Chloropicrin is applied as a pre-plant soil fumigant with immediate soil incorporation (i.e. injected into soil a minimum of 20 cm below surface and immediately sealed). Therefore, environmental exposure to birds and mammals from spray drift is not expected. However, potential exposure to birds and mammals may occur through inhalation of chloropicrin off-gassing from treated fields. Exposure from redeposition of volatilized chloropicrin via precipitation in terrestrial environment is expected to be negligible due to the short direct photolytic half-life ($t_{1/2}$ <8 hrs) of chloropicrin in the atmosphere. On this basis, dietary exposure by ingestion of contaminated food items such as grass and foliage contaminated from atmospheric redeposition via precipitation is not considered a substantial route of avian or mammalian exposure to chloropicrin.

For birds, the PMRA considered the acute (bobwhite quail 5-day LC_{50} of > 4.43 mg/m^3 or 0.00443 mg/L) (EFSA, 2011) and the subchronic (bobwhite quail NOAEC of 0.00065 mg/L) inhalation endpoints (United States, 2013). Based on the maximum reported ambient chloropicrin air concentration of 0.000014 mg/L (at ≥ 1.0 metres from the ground) from monitoring studies (United States, 2008a), the resulting risk quotients for birds are < 0.0032 (acute) and 0.02 (subchronic), and therefore, are not of concern. Based on the highest 90th percentile chloropicrin air concentration of 0.004219 mg/L (ground level) using the Probabilistic Exposure and Risk model for Fumigants (PERFUM) (United States, 2008a), the resulting RQs for birds are 0.95 (acute) and 6.5 (subchronic).

For mammals, the PMRA considered the acute inhalation endpoint (rat LC_{50} of 0.114 mg/L), and the chronic inhalation endpoint (based on the developmental NOAEL in rabbits of 0.003 mg/L; LOAEL of 0.008 mg/L, United States, 2008a). Based on the maximum reported ambient chloropicrin air concentration of 0.000014 mg/L, the resulting risk quotients for mammals are 0.00012 (acute) and 0.005 (chronic), and therefore, are not of concern. Based on an estimated chloropicrin air concentration of 0.004219 mg/L, the resulting RQs are 0.04 (acute) and 1.4 (chronic), respectively.

Based on the above analysis, acute inhalation risks to birds and mammals are not of concern. While, inhalation risks from potential repeated (subchronic or chronic) exposure slightly exceeded the level of concern, based on chloropicrin's use pattern as a pre-plant soil fumigant (applied once per year; injected and incorporated into soil), its environmental fate properties (rapid degradation) and its dissipation through the atmosphere, continuous exposure to birds and mammals is expected to be minimal and is not considered to be of concern.

The risk reduction measures implemented by the PMRA for soil fumigant products in 2014, including mandatory GAPs (Canada, 2012a) further minimizes potential exposure to birds and mammals (such as, application methods minimizing the release of chloropicrin emissions from treated fields, and environmental hazard precautionary statements).

Based on chloropicrin's use as a remedial wood preservative (injected into pre-drilled holes and sealed), environmental exposure is expected to be minimal and is not considered to be of concern, and no further risk reduction measures beyond those currently on product labels are proposed.

No incidents related to these aspects of concern were submitted through the Health Canada Pesticide IRP.

5.0 Proposed Special Review Decision for Chloropicrin

Evaluation of available relevant scientific information related to the aspects of concern for human health and the environment, indicated that the registered products containing chloropicrin are acceptable for continued registration, taking into account the current conditions of use. On this basis, the PMRA is proposing to confirm the current registration of chloropicrin products for sale and use in Canada pursuant to subsection 21(1) of the *Pest Control Products Act*.

This proposed special review decision is a consultation document.[1] The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (please see contact information on the cover page of this document).

[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

6.0 Next Steps

Before making a special review decision on chloropicrin, the PMRA will consider any comments received from the public in response to this consultation document. A science-based approach will be applied in making a final decision on chloropicrin. The PMRA will then publish a special review decision document, which will include the decision, the reasons for it, a summary of the comments received on the proposed decision and the PMRA's response to these comments.

Appendix I Registered Products Containing Chloropicrin as of 01 June 2016

Registration Number	Marketing Class	Registrant	Product Name
25669	Technical	Trinity Manufacturing Inc.	CHLOROPICRIN TECHNICAL
14588	Commercial	Timber Specialties Co	TIMBER FUME
13477	Restricted	Great Lakes Chemical Corporation	TERR-O-GAS 67 PREPLANT SOIL FUMIGANT
25863	Restricted	Triest AG Group, Inc.	CHLOROPICRIN 100 LIQUID SOIL FUMIGANT
28715	Restricted		PIC PLUS FUMIGANT

References

Published Information

PMRA Document Number	Reference
2226693	Canada, 2012a. Pest Management Regulatory Agency Re-evaluation Note REV2012-09, Label Amendments for Soil Fumigant Products Containing Chloropicrin.
2226695	Canada, 2012b. Pest Management Regulatory Agency Re-evaluation Note REV2012-07, Chloropicrin, Dazomet, Metam Sodium and Metam Potassium - Label Amendments for Antimicrobial Products.
2226738	Canada, 2012c. Pest Management Regulatory Agency Re-evaluation Note REV2012-08, Chloropicrin, Dazomet, Metam Sodium and Metam Potassium - Label Improvements for Soil Fumigant Products.
2405939	Canada. 2013. Pest Management Regulatory Agency. Regulatory Note REV2013-06, Special Review Initiation of 23 Active Ingredients.
2648158	EFSA, 2011. Conclusion on the peer review of the pesticide risk assessment of the active substance chloropicrin. European Food Safety Authority, 2011. EFSA Journal 2011;9(3):2084.
2648160	European Commission, 2011a. Review report for the active substance chloropicrin finalised in the Standing Committee on the Food Chain and Animal Health at its meeting on 11 October 2011 in view of the non approval of chloropicrin as active substance in accordance with Regulation (EC) No 1107/2009. Chloropicrin SANCO/11440/2011 rev.4
2648159	European Commission, 2011b. Commission Implementing Regulation (EU) No 1381/2011 of 22 December 2011 concerning the non-approval of the active substance chloropicrin, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending Decision 2008/934/EC.
2562866	United States, 2008a. Revised Screening Ecological Risk Assessment for the Reregistration of Chloropicrin. United States Environmental Protection Agency, 2008. EPA-HQ-OPP-2007-0350-0175.
2562865	United States, 2008b. Revised Occupational and Residential/Bystander Assessment of the Antimicrobial Use (Remedial Wood Treatment) of Chloropicrin for the Reregistration Eligibility Decision (RED) Document (Phase 3 Comment Period). PC Code 081501, DP Barcode D314399. February 14, 2008.
2562868	United States, 2009a. Amended Reregistration Eligibility Decision (RED) for Chloropicrin. United States Environmental Protection Agency, May 2009. EPA-HQ-OPP-2007-0350-0396.
2562869	United States, 2009b. Chloropicrin: Third Revision of the HED Human Health Risk Assessment. United States Environmental Protection Agency, April 30, 2009. EPA-HQ-OPP-2007-0350-0398.
2648161	United States, 2013. EFED Registration Review Problem Formulation for Chloropicrin.

Unpublished Information

PMRA Document Number	Reference
2125716	Review of US Groundwater Monitoring Data for Consideration by PMRA, Canada, October 7, 2010.